Evolution, Characterization & Optimization of varying composition of FeMoCrNiBWC high entropy alloy using Laser Cladding Process

SHORT SYNOPSIS

Submitted in partial fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

by

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Year *2023*

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Prof. (Dr.) I.K. Bhat

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ABSTRACT

The main component used for generating the hydro power is a turbine which has blades on which the water flows causing wear and tear of the blades. To withstand wear and tear of the blade from flowing water these blades have to resist the dynamic forces. This requires that the material of the turbine should have good wear resistance, corrosive resistance, erosive resistance and also high strength to work under the impact of the flowing water. It is already established that erosion is caused mainly due to the erodent particles found as solid particulate in flowing water. Further the type, size, velocity of flow and the angle at which impinges on the blade also are found to be responsible for the erosion of the material.

Keywords: Hydro-turbine, Erosion, Wear Resistance

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Introduction:

High Entropy Compounds or HEAs for short, are alloying frameworks made out of no less than 5 components at practically equivalent amounts. Depend on the expansion of Configurational Entropy, which can balance out strong arrangement stages, against intermetallic compounds. HEAs where first and foremost detailed in 1996 by Huang KH and Yeh JW, but the interest for the field didn't create until 2004, when the two separate groups of Jien-Wei Yeh and Brian Cantor distributed a few huge outcomes.

Broad Spectrum of HEAs:

Properties or Execution Wear opposition, Oxidation obstruction, Consumption opposition.

- Union/Handling Circular segment softening, mechanical alloying, combinatorial methodology
- Piece Equi-nuclear, Close to equi-nuclear
- Structure/Miniature construction FCC/BCC/indistinct, Strong Arrangement/request hastens/glasses

Challenges & Prospects:

Challenges

- Arrangement of various stages in HEAs.
- Likewise, because of the incredibly big number of potential creations for HEAs, albeit a couple might demonstrate helpful, distinguishing valuable compound sytheses by means of the customary experimentation technique has become troublesome, which requires a productive high-throughput strategy for composite screening.

Prospects

- HEAs were found to have novel properties like brilliant explicit strength, astounding mechanical execution at high temperature, extraordinary pliability and crack sturdiness at cryogenic temperatures, super para attraction, and superconductivity.
- These properties are promising for new revelations and developments in future, which may at last prompt new applications.

Literature Review:

D.D.Coimbr~ao et al. The consumption conduct was assessed in chloride rich media at different value of pH, going in acidic nature to antacid nature. At higher consumption, obstruction noticed for the new $Fe_{68}Cr_8Mo_4Nb_4B_{16}$ shapeless amalgam in the proposed media and pHs. The indistinct stage contains consumption safe alloy components, for example, chromium and molybdenum prompted the development of an exceptionally steady passivating film, which covered and safeguarded the dynamic uncovered metal surface.

Yingbo Peng et al. The non-equi-molar high entropy alloy (HEA) film $(FeCoNi)_{25}(TiZrAl)_{75}$ was created in this work using magnetron faltering, another type of MEMS. The results demonstrated that the HEA film had a polycrystalline structure with a strong FCC arrangement that was consistently expressed in the undefinable stage.

Fengyuan Shu et al. By varying laser powers, CoCrBFeNiSi high-entropy mix (HEA) coatings were applied to H13 steel. In order to distinguish between the wear resistance of various coatings, 3D wear follow morphology was included into the analysis of the covering's microstructure, mechanical, and material properties as well as the internal relationships between them.

Fa Chang et al. The high-entropy composite coatings FeCrxCoNiB (x properties in molar alloy, x=0.5~3) were created by laser cladding an AISI 1045 steel substrate. Because of the boride, which achieves 860HV at x=0.5, the coatings' hardness value is addressed on a very basic level. Cr is helpful in reducing boride coarsening and improving coating resistance to rising temperatures.

The goals of the Proposed Research are:-

i. The work on non equi-molar proportion has gotten less consideration.

ii. The creation of high temperature component combination needs further examination comparable to microstructure and mechanical properties of FeMoCrNiBWC amalgam on SS316L steel substrate by Laser Cladding.

iii. The impact on tribological properties of FeMoCrNiBWC amalgam on SS316L substrate

iv. Study on mechanical and disintegration erosion wear conduct of FeMoCrNiBWC combination by utilizing Advancement method of Multi Models Navigation.

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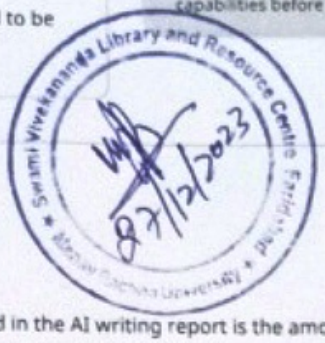

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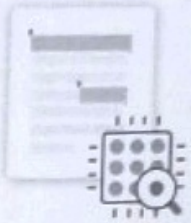

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